REMARKS

Claims 1-7 are presently pending in the application.

Claim 1 has been amended for clarity to positively recite that the polyol is "the polycondensation reaction product of..." rather than "is obtainable by polycondensation of..." Claim 6 has been similarly amended. Claim 7 has been amended to recite that the hot melt adhesive "comprises..." rather than "is used..." Minor amendments have been made to claims 4 and 5 for clarity. No new matter has been added by these amendments, and entry is respectfully requested.

In the Office Action, the Examiner has rejected claims 1-7 under 35 U.S.C. § 112, second paragraph, as being indefinite with respect to "obtainable" and the use recited in claim 7. The claims have been amended to delete "obtainable by" and to positively recite that the polyol and prepolymer are reaction products. Further, claim 7 has been amended to delete "is used" and to recite "comprises." Accordingly, withdrawal of the § 112 rejections is respectfully requested.

The Examiner has also rejected claim 7 under 35 U.S.C. § 101, arguing that there are no recited steps in the process claim. In view of the amendment to claim 7, which is now a product claim, reconsideration and withdrawal of the rejection are respectfully requested.

Finally, the Examiner has rejected claims 1 and 5-7 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,120,895 of Kowitz et al. ("Kowitz"), and claims 3-4 have been rejected under 35 U.S.C. § 102(b) or § 103(a) as being anticipated by or obvious over Kowitz. Further, the Examiner has rejected claims 1-7 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Application Publication No. 2003/0144454 of Krebs ("Krebs") in view of Kowitz. Finally, the Examiner has rejected claims 1-7 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,100,995 of Munzmay et al. ("Munzmay") or based on Munzmay in view of Kowitz. Applicants respectfully traverse these rejections and the arguments in support thereof as follows, and respectfully request reconsideration and withdrawal of the rejections.

The Presently Claimed Invention

The presently claimed invention relates to a crystalline polyester polyol, a urethane prepolymer obtained via reaction of the polyol and a polyisocyanate, and a hot-melt adhesive which contains the prepolymer. The crystalline polyester polyol according to the presently

claimed invention is the polycondensation reaction product of a dicarboxylic acid component comprising 85 to 99 mol % of an aromatic dicarboxylic acid and 15 to 1 mol % of a specific aliphatic dicarboxylic acid having the formula $HOOC-(CH_2)_n-COOH$ (n = 8 to 10), with an aliphatic diol component having the formula $HO-(CH_2)_m-OH$ (m = 11 to 20). Applicants have determined that the ratio of aliphatic dicarboxylic acid to aromatic dicarboxylic acid is critical for providing the desired properties of the polyol and resulting prepolymer: when the amount of aromatic dicarboxylic acid is less than 85 mol %, the balance between surface hardness and setting time becomes insufficient. Further, if the aromatic dicarboxylic acid is used alone, there is poor efficiency of working the material.

The crystalline polyester polyols according to the presently claimed invention preferably have a melting point of 90 to 120°C. Applicants have determined that melting points lower than 90°C or higher than 120° C lead to urethane prepolymers which exhibit slower setting time, poor thermal resistance, and/or a decrease in efficiency of working during production. It is also preferred that the crystalline polyols have enthalpies of crystallization using DSC of 55 J/g or more. Lower enthalpies have been found to remarkably decrease crystallinity, retard setting time, and/or decrease surface hardness. Since melting point and enthalpy of crystallization are determined by the structure of the polyol, the ratio of aromatic to aliphatic dicarboxylic acids is critical for providing the polyester polyol and the resulting urethane prepolymer and hot-melt adhesive produced therewith with the desired properties.

The criticality of the claimed ratio is clearly demonstrated in the examples and comparative examples of the specification, and in particular in Tables 1-3 of the specification. Specifically, when the ratio of aliphatic dicarboxylic acid (such as dodecanedioic acid) to aromatic dicarboxylic acid (such as terephthalic acid) does not fall within the claimed range, the physical properties of the crystalline polyester polyol and the resulting urethane prepolymer and hot-melt adhesive prepared therefrom are inferior. For example, in Examples 1-3 of Table 1, the crystallization enthalpies of the inventive crystalline polyester polyols are greater than 55 J/g as claimed. In contrast, when the concentration of aromatic dicarboxylic acid is 80 mol % (Comparative Example 7, below the claimed range) or the concentration of aliphatic dicarboxylic acid is 20 mol % (Comparative Example 5, above the claimed range), the crystallization enthalpies of the resulting polyester polyols are too low: 32.9 J/g and 32.9 J/g, respectively.

setting properties, high hardness, and excellent efficiency of working as hot-melt adhesives. However, when the amount of terephthalic acid in the polyester polyol is less than 85 mol %, setting time was short and the efficiency of working was excellent, but the surface hardness decreased. When terephthalic acid was eliminated (100% aliphatic dicarboxylic acid), the urethane prepolymer prepared from the resulting polyester polyol exhibited prolonged setting time. Similarly, the urethane prepolymer prepared from a polyester polyol containing no dodecanedioic acid exhibited short setting time and sufficient surface hardness, but the efficiency of working remarkably decreased due to an unacceptably high viscosity at melting. Accordingly, Applicants have clearly demonstrated the optimum ratio of aromatic dicarboxylic acid to aliphatic dicarboxylic acid in the polyester polyol.

The specific dicarboxylic acids which are utilized are also important for providing the desired properties. As demonstrated in the examples and comparative examples and summarized in paragraph [0036], when adipic acid is used as the aliphatic dicarboxylic acid, setting time of the urethane prepolymer is prolonged, which is undesirable. In order to avoid such problems, the specification teaches that the aliphatic acid may be sebacic or dodecanedioic acid (paragraph [0012]), for example, with dodecanedioic acid being preferred.

Rejections Under § 102(b) and § 103(a) Based on Kowitz

Regarding claims 1 and 5-7, the Examiner argues that Kowitz teaches a polyurethane hot-melt adhesive based on the reaction product of polyisocyanate and polyester polyol, wherein the polyester polyol is the reaction product of aliphatic and aromatic dicarboxylic acid and aliphatic diol. It is allegedly taught that the aliphatic diol consists of dodecanediol, the aromatic and aliphatic dicarboxylic acid are present in amounts of 20-95 mol% and 5-80 mol%, respectively, and the resulting polyester has an average molecular weight as low as 5,000 g/mol.

Regarding claims 3 and 4, the Examiner acknowledges that Kowitz does not teach or suggest specific melting points or enthalpy at crystallization on a differential scanning calorimeter. However, the Examiner takes the position that based on the allegedly analogous reagents, overlapping molar amounts, and identical applications, the polyester of Kowitz would inherently exhibit the claimed properties. Applicants respectfully traverse these rejections as follows.

Initially, Applicants respectfully traverse the Examiner's understanding of Kowitz. The Examiner argues that Kowitz teaches that the aromatic dicarboxylic acid is present in an amount of 20-95mol %. To the contrary, Kowitz teaches that the aliphatic dicarboxylic acid is present in such an amount. Accordingly, the ratio of aromatic dicarboxylic acid to aliphatic dicarboxylic acid which is taught by Kowitz does not overlap with the claimed ratio. That is, Kowitz teaches a composition comprising 20 to 95% aliphatic dicarboxylic acid and 5-80% aromatic dicarboxylic acid, and does not teach or suggest the claimed ratio of 1 to 15% aliphatic dicarboxylic acid and 85 to 99% aromatic dicarboxylic acid. In other words, the composition of Kowitz contains a greater percentage of aliphatic dicarboxylic acid and a lower percentage of aromatic dicarboxylic acid than claimed, and Kowitz does not teach or suggest adjusting the ratios to fall within the claimed range. Accordingly, there would have been no motivation based on Kowitz to produce the crystalline polyester polyol according to the presently claimed invention by setting the ratio of aromatic dicarboxylic acid to aliphatic dicarboxylic acid to the claimed ratio. As previously demonstrated, the presently claimed ratio is critical for providing the observed properties, including surface hardness, efficiency of working, and operation time of hot melt adhesives. Such results would not have been expected based on Kowitz.

Additionally, as demonstrated above, the specific aromatic and aliphatic dicarboxylic acids are critical for providing the observed properties. For example, the claimed aliphatic acid has the formula $COOH(CH_2)_nCOOH$, in which n may be 8 (sebacic acid) or 10 (dodecanedioic acid), for example, with dodecanedioic being preferred (paragraph [0012] of the specification). Further, as demonstrated in the examples and comparative examples and summarized in paragraph [0036], when adipic acid (n = 4) is used as the aliphatic dicarboxylic acid, setting time of the urethane prepolymer is prolonged, which is undesirable.

Although Kowitz indeed teaches an aliphatic dicarboxylic acid, Kowitz teaches in col. 3, lines 44-48 that preferred are adipic acid and sebacic acid, respectively having "n" values of 4 and 8. As previously explained, adipic acid, which is an appropriate dicarboxylic acid in the polyol of Kowitz, has been found by Applicants to produce inferior results. The fact that Kowitz teaches the inclusion of sebacic or adipic acid indicates that Kowitz does not recognize the criticality of the particular aliphatic carboxylic acid, and thus it would not have been expected based on Kowitz that the use of the particularly claimed aliphatic carboxylic acid in the claimed

ratio of aromatic to aliphatic dicarboxylic acids would result in the results observed from the presently claimed invention.

Finally, Kowitz does not teach or suggest that the polyester polyol is a crystalline polyester polyol. In fact, when the hot-melt adhesive is biodegradable, as described in Kowitz, the polyester polyol to be used is not a crystalline polyester as claimed. As acknowledged by the Examiner, Kowitz does not teach or suggest the melting point or the enthalpy during crystallization of the polyester polyols. Since the polyols of Kowitz have different compositions than the claimed polyols, they would not exhibit the claimed melting points or enthalpies of crystallization.

For these reasons, the present claims are not anticipated by or obvious over Kowitz. Reconsideration and withdrawal of the § 102(b) and § 103(a) rejections are respectfully requested.

Rejection Under § 103(a) Based on Krebs in view of Kowitz

Regarding claims 1-7, the Examiner argues that Krebs teaches a polyurethane hot-melt adhesive based on the reaction product of a polyester polyol and polyisocyanate, wherein the polyester has an average molecular weight as much as 10,000 and is based on aliphatic diol, and a mixture of aromatic and aliphatic dicarboxylic acid. In particular, Krebs allegedly teaches that the aliphatic dicarboxylic acid and diol consist of dodecanedioic acid and dodecanediol, respectively. The Examiner acknowledges that Krebs does not teach or suggest the amount of the respective species that comprise the dicarboxylic acid mixture. However, the Examiner argues that Kowitz teaches a polyurethane hot-melt adhesive comprising the reaction product of polyisocyanate and polyester polyol, in which the polyester is based on both aliphatic and aromatic dicarboxylic acid in relative amounts which overlap the claimed range, and that such compositions based on these ratios result in adhesives that exhibit excellent heat resistance, surface quality, and mechanical properties. Accordingly, the Examiner concludes that it would have been obvious to one having ordinary skill in the art at the time of the invention to adjust the amounts of aliphatic and aromatic dicarboxylic acids in the Krebs composition based on the teaching of Kowitz that such ratios would result in a polyurethane adhesive that displays superior performance properties. Further, the Examiner concludes that the claimed properties would have

been expected based on identical reactants and amounts. Applicants respectfully traverse this rejection as follows.

As acknowledged by the Examiner, Krebs does not teach or suggest using an aromatic dicarboxylic acid in an amount greater than that of the aliphatic dicarboxylic acid, the claimed ratio, or that a crystalline polyester polyol is obtained. As previously described, the presently claimed invention relates to a crystalline polyester polyol, useful as a starting material for a hot-melt adhesive, which is the product of specific relative amounts of an aromatic dicarboxylic acid and a specific aliphatic dicarboxylic acid. Despite the Examiner's assertion to the contrary, Kowitz does not teach or suggest the claimed ratio, and thus even the proposed combination of Krebs and Kowitz would not teach or suggest all of the claimed elements. Additionally, since the proposed Krebs/Kowitz polyol would be completely different from the presently claimed material, it would not inherently or obviously exhibit the claimed properties, such as melting point and enthalpy during crystallization. Accordingly, reconsideration and withdrawal of the § 103(a) rejection based on Krebs in view of Kowitz are respectfully requested.

Rejections Under § 103(a) Based on Munzmay or Munzmay in view of Kowitz

Finally, regarding claims 1-7, the Examiner argues that Munzmay teaches a polyurethane hot-melt adhesive based on the reaction product of a polyester polyol and polyisocyanate, wherein the polyester has an average molecular weight as high as 10,000 and is based on aliphatic diol, and a mixture of aromatic and aliphatic dicarboxylic acid. Munzmay allegedly teaches that the aliphatic dicarboxylic acid and diol consist of dodecanedioic acid and dodecanediol, and that the resulting polyester has a melting point between 40 and 150°C. The Examiner acknowledges that Munzmay does not teach the amounts of aliphatic and aromatic dicarboxylic acids, but takes the position that it would have been obvious to arrive at the claimed range as mere optimization, and further that the resulting polyester would exhibit the claimed properties.

Alternatively, the Examiner argues that it would have been obvious to one having ordinary skill in the art at the time of the invention to adjust the amounts of aliphatic and aromatic dicarboxylic acids in Munzmay based on the teachings of Kowitz that such a ratio would result in a polyurethane adhesive that displays superior performance properties. The

Examiner concludes that the resulting polyester would have been expected to exhibit the claimed properties. Applicants respectfully traverse these rejections as follows.

Munzmay teaches polyurethane adhesives which are prepared from a polyester polyol and a polyisocyanate. In col. 3, lines 19-22, Munzmay teaches that the polyols may be prepared "in known manner from aliphatic, cycloaliphatic, or aromatic dicarboxylic acids." No guidance is provided as to the relative amounts of the components that may be included. In Examples 1-7 of Munzmay, an aliphatic dicarboxylic acid is utilized in an amount of 100 mol %, and it is only in Comparative Example 6 that an aromatic dicarboxylic acid is included. Specifically, Munzmay teaches in this Comparative Example that the ratio of terephthalic acid (aromatic dicarboxylic acid) to adipic acid (aliphatic dicarboxylic acid) is 5:2.5: an amount of aromatic dicarboxylic acid of 66.6% and an amount of aliphatic dicarboxylic acid of 33.3 mol%. The resulting polyester was found to be inferior in properties, such as firmness, to the polyesters prepared in the inventive Examples of Munzmay. Accordingly, based on Munzmay, one would not have been motivated to include an aromatic dicarboxylic acid, and certainly not to include such a component in an amount of 85 to 90 mol % as claimed. Further, even if the proposed combination of Munzmay and Kowitz were proper, neither describes the ratio of the aromatic dicarboxylic acid to aliphatic dicarboxylic acid as claimed. Finally, the results observed from the presently claimed polyol and resulting urethane prepolymer and hot melt adhesive would not have been expected based on Munzmay or the proposed combination of Munzmay with Kowitz. Accordingly, reconsideration and withdrawal of the § 103(a) rejections based on Munzmay or Munzmay in view of Kowitz are respectfully requested.

In view of the preceding Amendments, it is respectfully submitted that the present claims are in full compliance with § 112. In view of the Remarks, the claims are patentably distinct over the prior art of record and in condition for allowance. A Notice of Allowance is respectfully requested.

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